



Understanding GSHP – Principles, Technology, and Types of Systems

Presented by:

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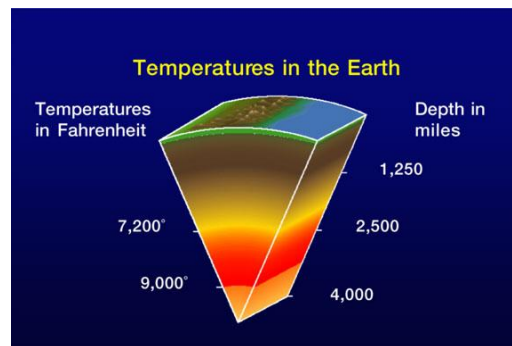


What This Module Is About

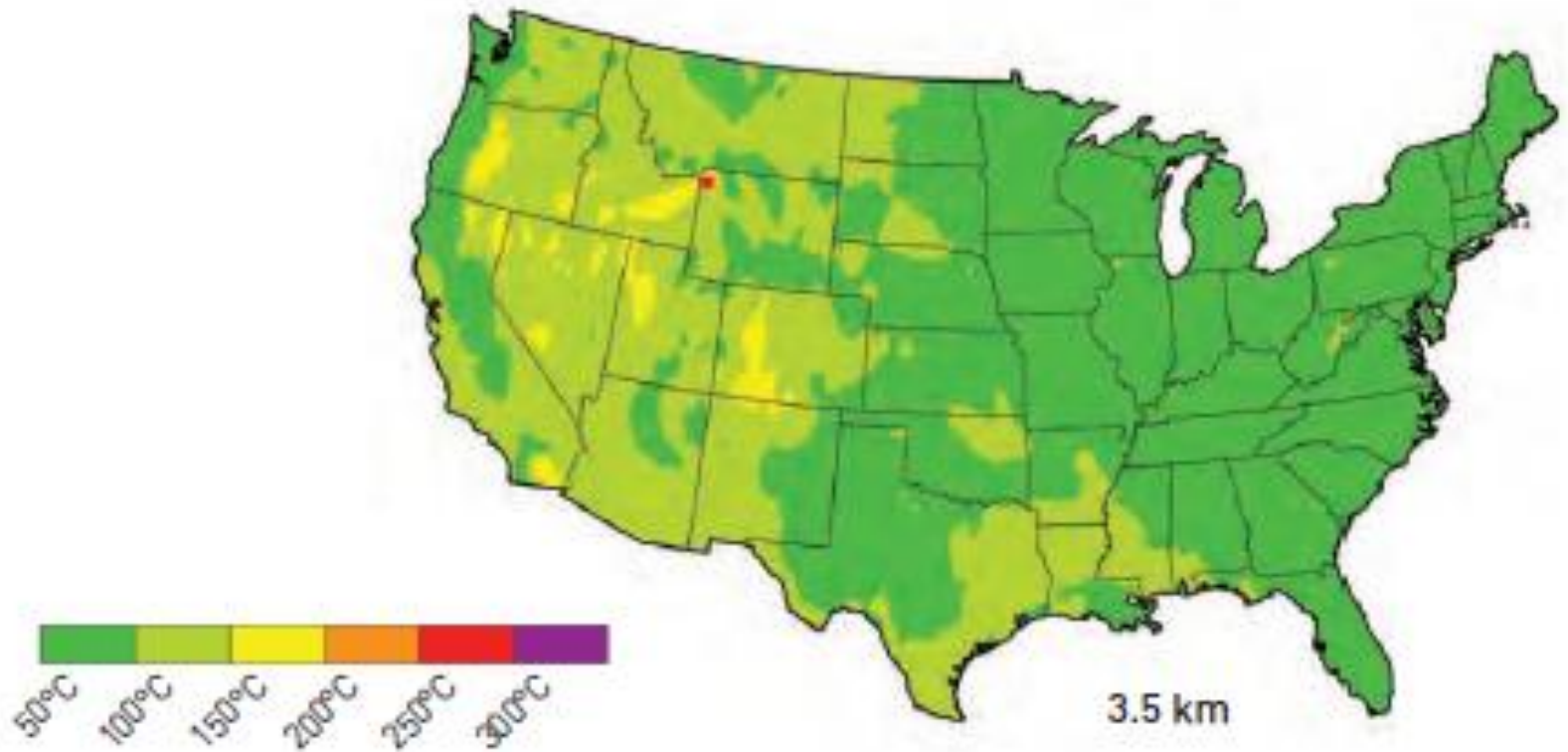
- ◆ What is geothermal?
- ◆ How it works
- ◆ Types of systems
- ◆ Typical applications

What is Geothermal?

- ◆ Two types of geothermal energy:
 - High-Grade Geothermal: One from earth's deep internal heat generation (i.e. used for power generation).
 - Low-Grade Geothermal: The other from solar energy stored in the earth's surface (i.e. used for heating & cooling)



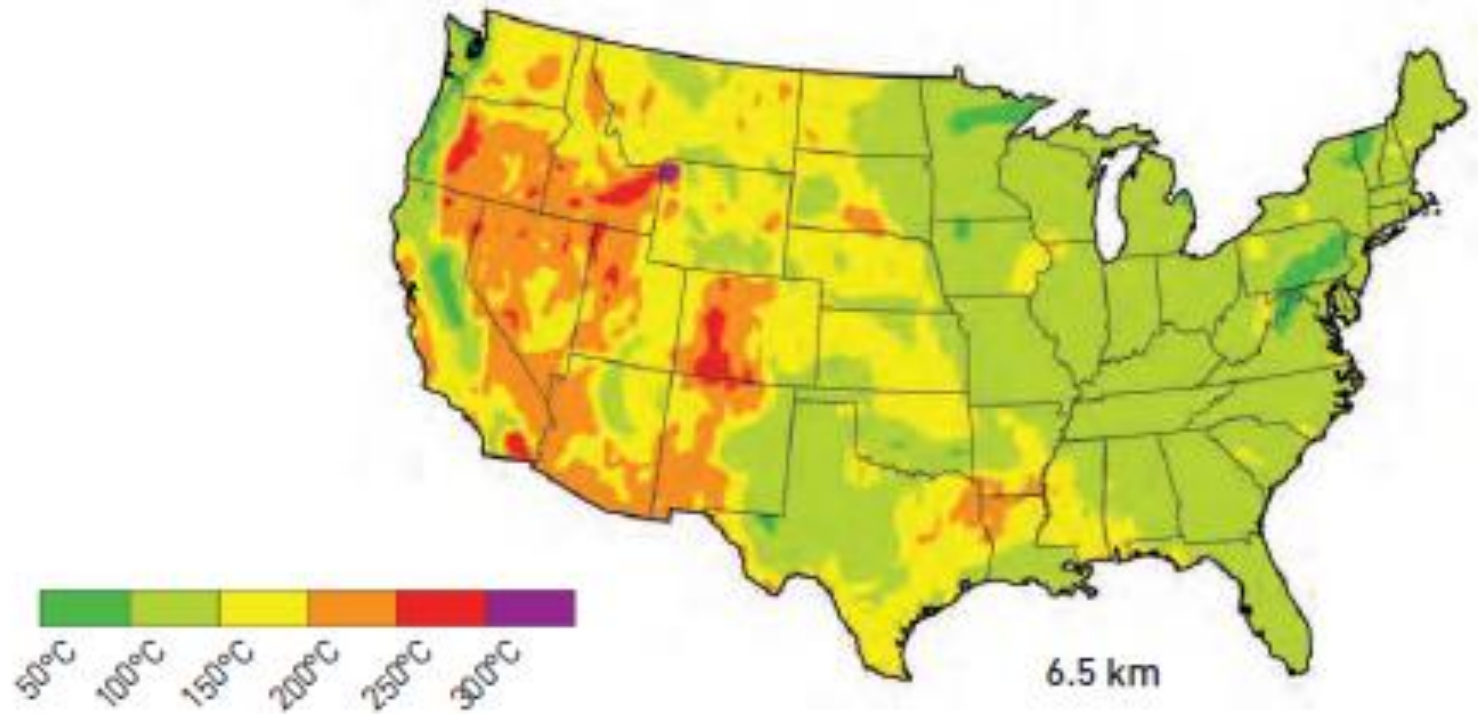
High Grade Geothermal



122F – 572F

Taken from Idaho National Laboratory, USDOE,
The Future of Geothermal Energy, 2006

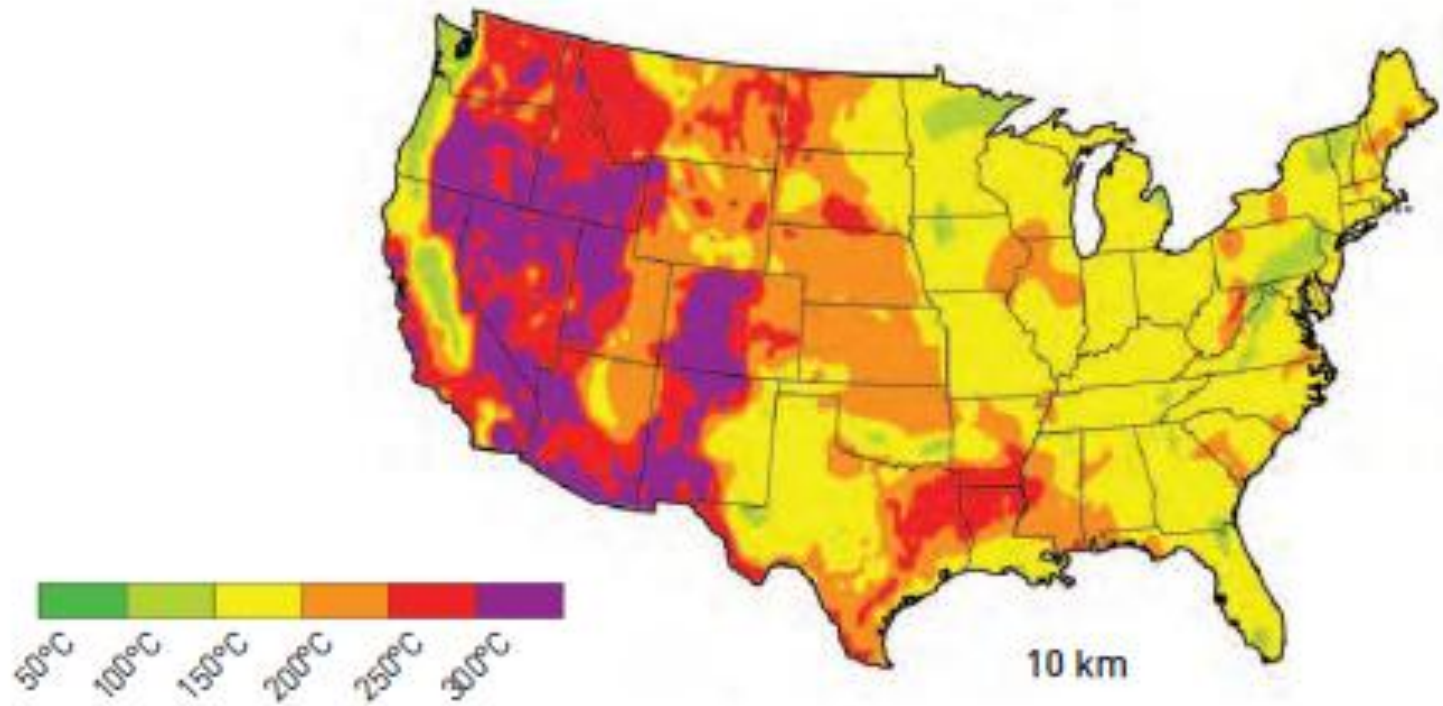
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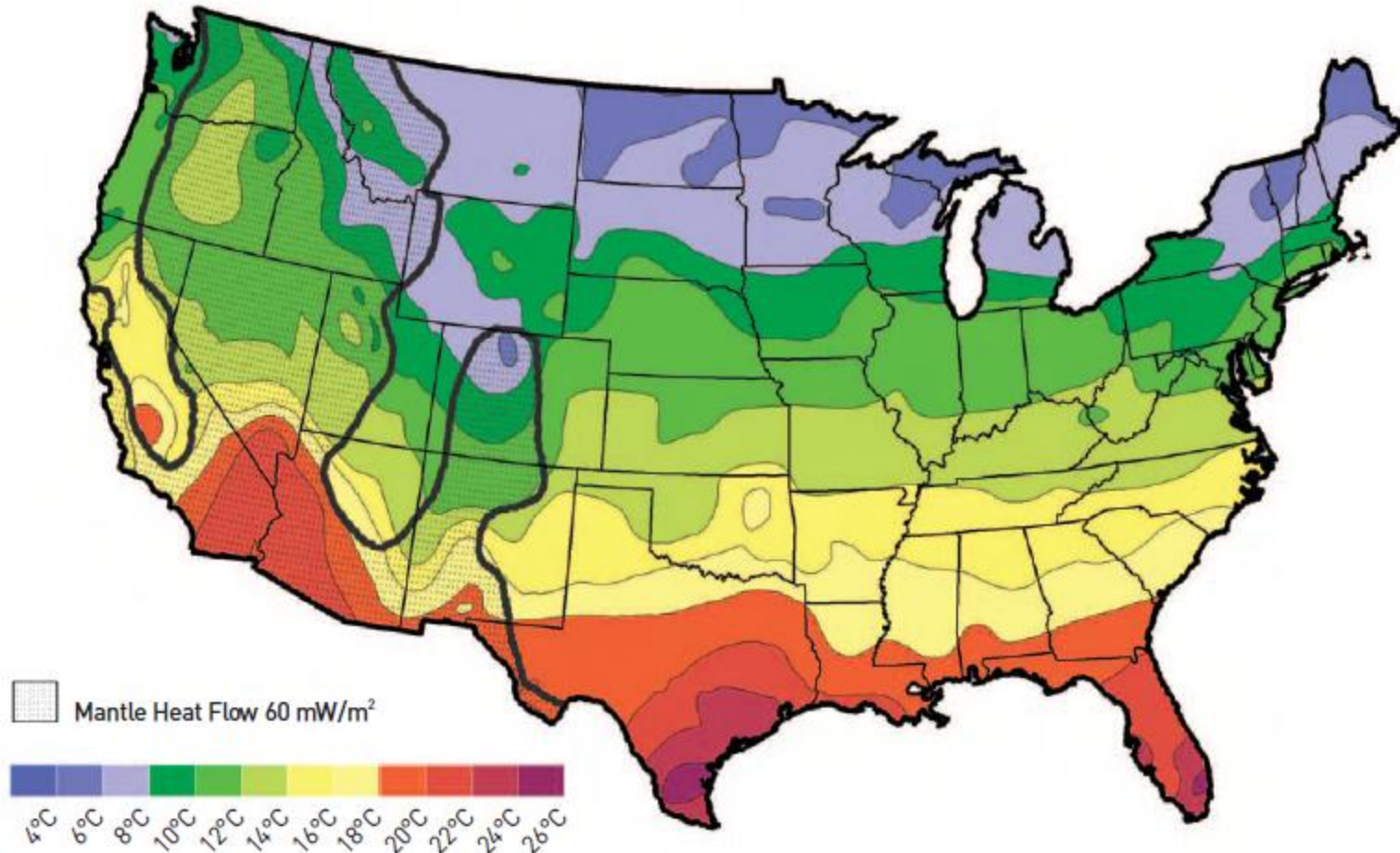
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Average Surface Temperatures



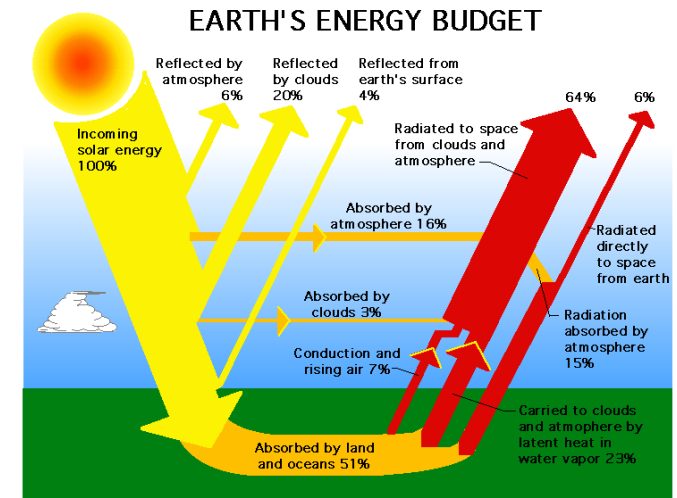
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High-Grade Geothermal

- ◆ From earth's internal heat
- ◆ Energy producing
- ◆ Renewable
- ◆ Requires temperatures $>150^{\circ}\text{C}$ (300°F)
- ◆ Resources $<3\text{Km}$ (10,000 ft) to 10KM (30,000 ft)
- ◆ Developable U.S. Resources = 100 Gigawatts
- ◆ Not what this course is about

Low-Grade Geothermal

- ◆ Solar influenced heat
- ◆ Energy leveraging (not producing)
- ◆ Energy efficiency (not renewable)
- ◆ Requires temperatures 45F to 65F
- ◆ Resources <1,500 feet (commercial drilling limit of technology)
- ◆ Subsurface functions as heat-source in winter and heat-sink in summer.
- ◆ Needs ground source heat pump (GSHP)
- ◆ That's what we're here for

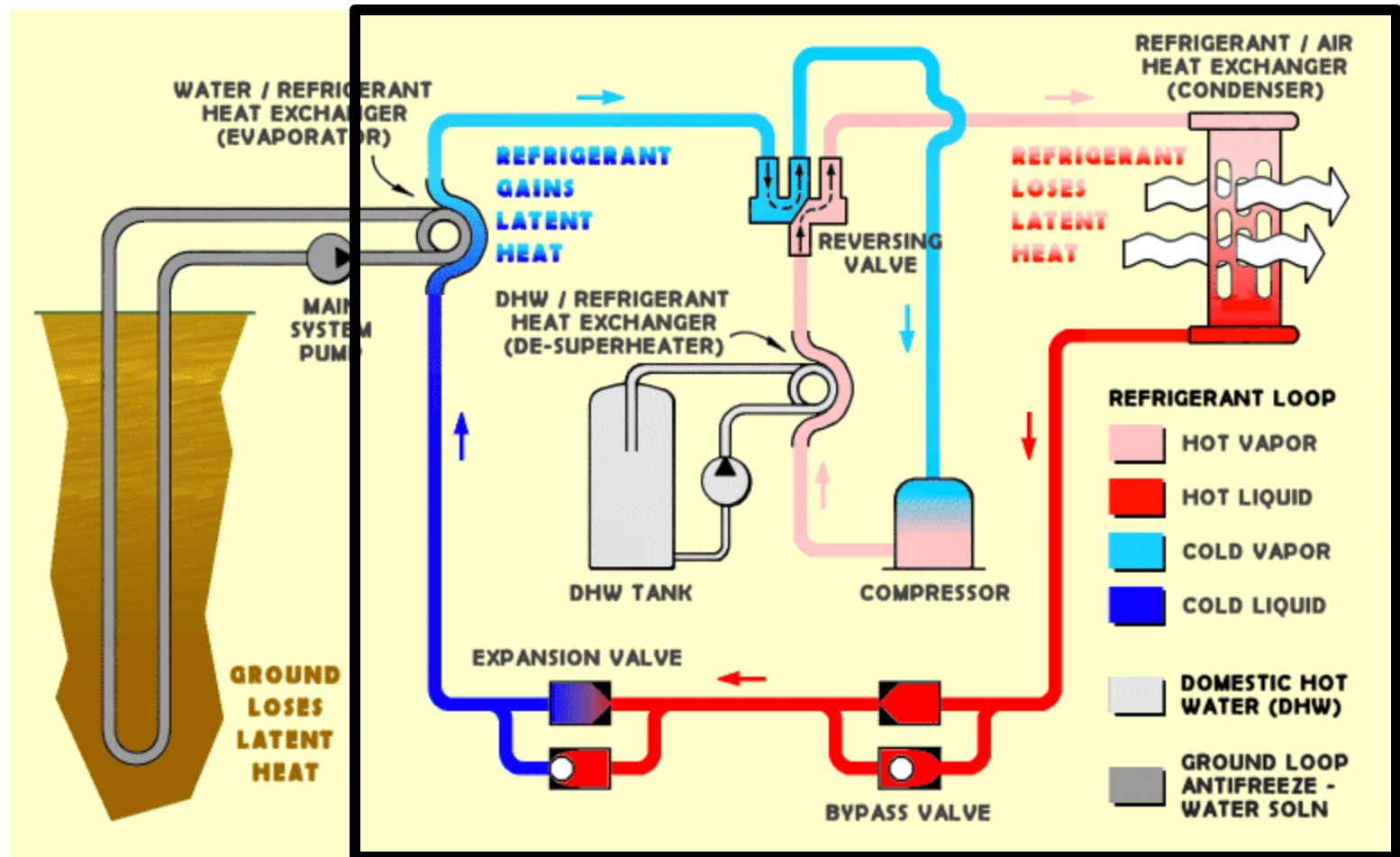


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How can 50 Degree Water Heat My House to 70 Degrees?

- ◆ Think of subsurface as a thermal reservoir. Not direct heating or cooling
- ◆ Heat pump to transfer/concentrate thermal energy through refrigeration/compression process



Results in 100F-130F forced hot water heat
(conventional boiler: 160F-180F)

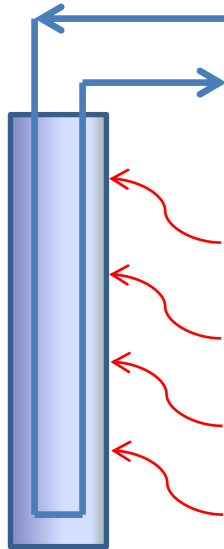


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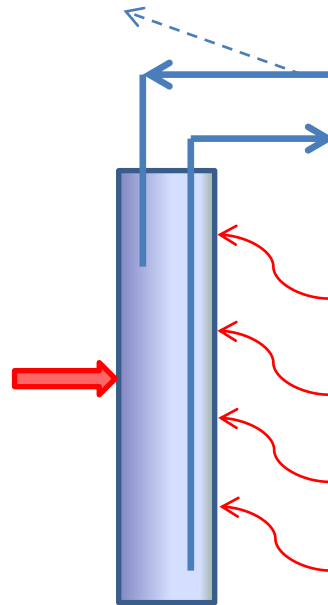
Main Geo Earth-Coupling Types

Closed Loop



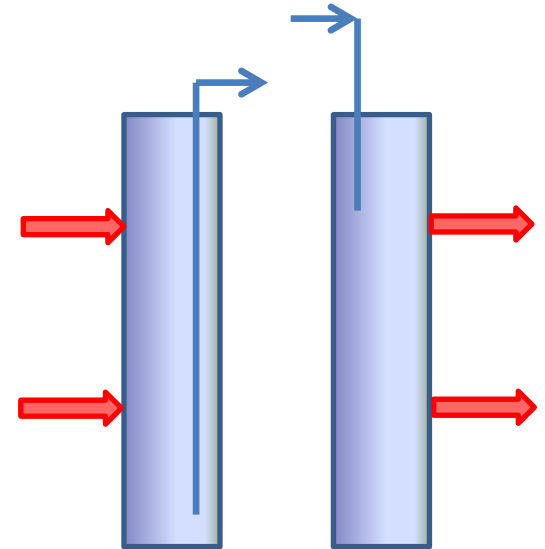
Glycol

Standing Column



Groundwater

Open to Diffusion

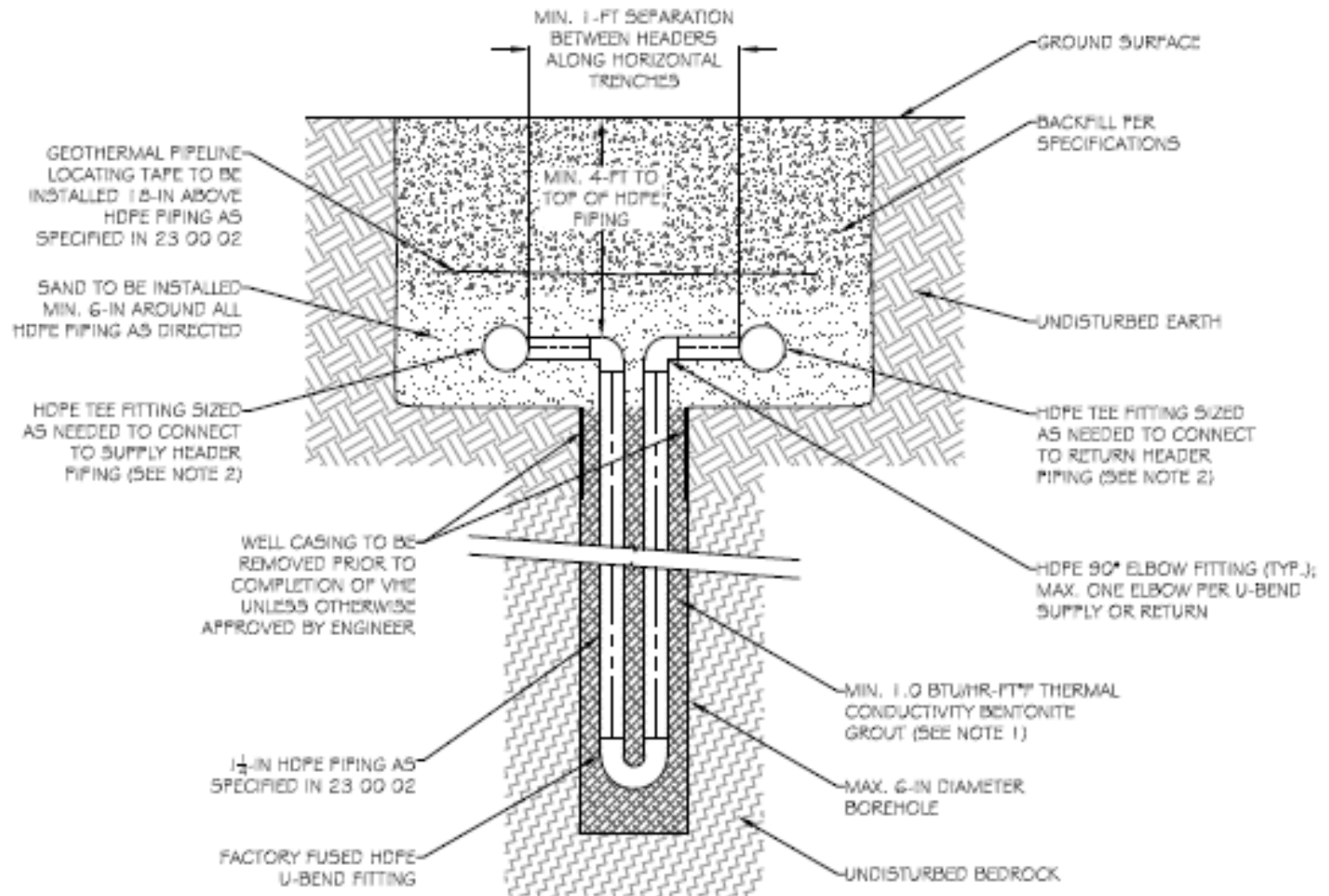


Groundwater

Closed Loop

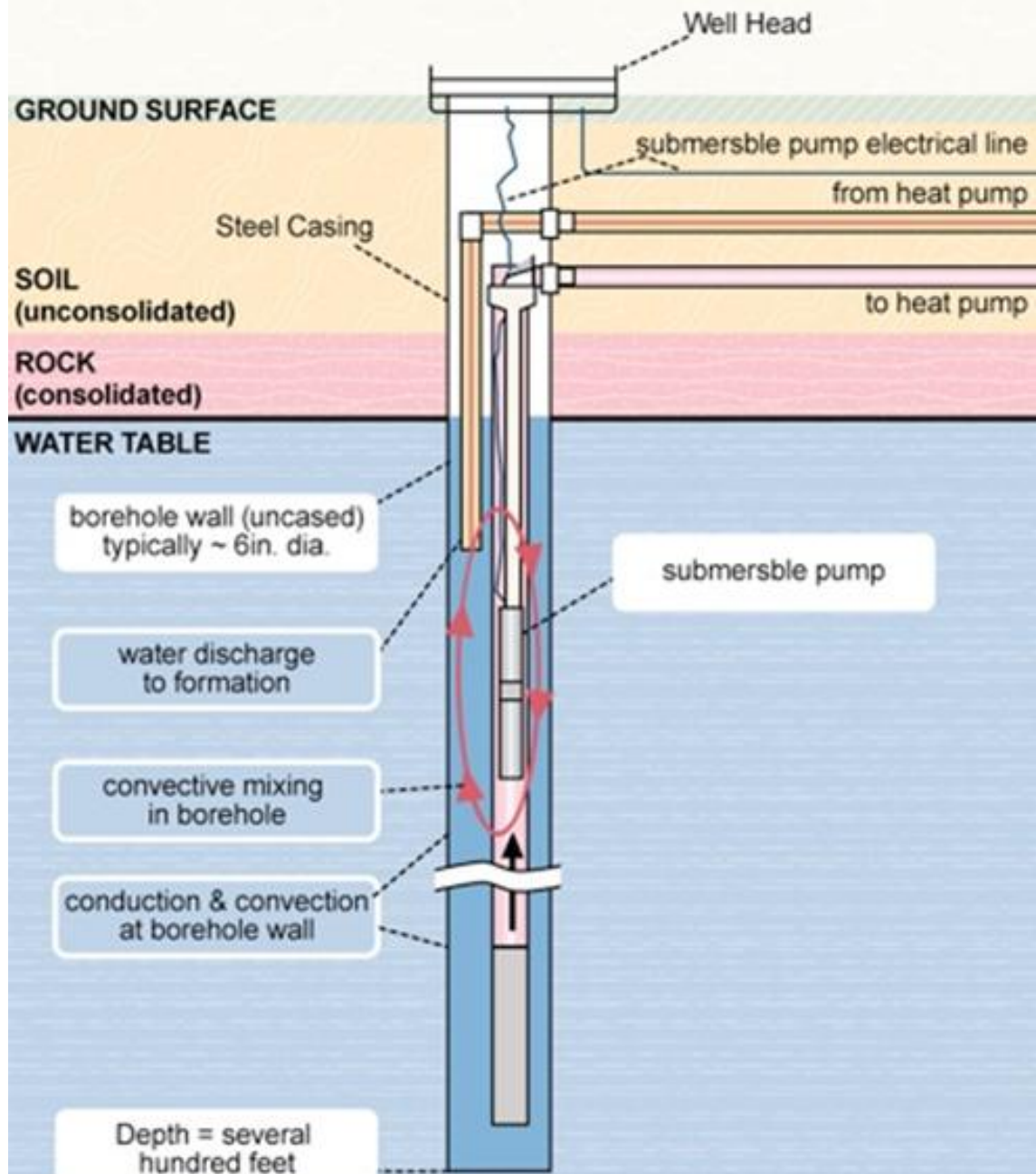
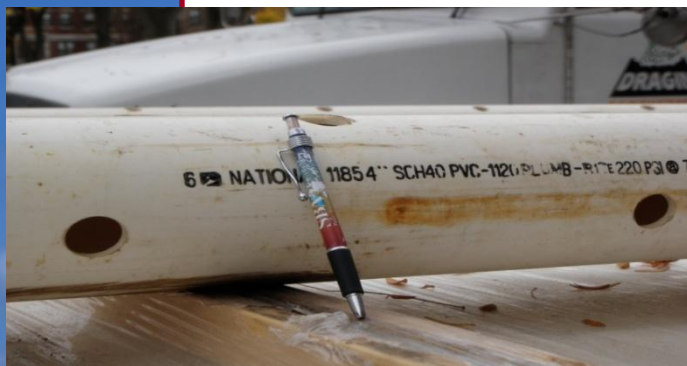


Closed Loop Vertical Borehole



GEOHERMAL BOREHOLE DETAIL
NOT TO SCALE

Standing Column Well



Heat Pumps



Earth-Coupling Comparison

	Closed Loop	Standing Column	Open-Diffusion
Install Cost	3	2	1
Efficiency	3	2	1
Geology	1	2	3
Maintenance	1	2	2

1 = Highest/Best
Comparative Rating

Open Systems are least costly to install and most efficient, given the proper conditions



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Common Applications

- ◆ Individual residence
- ◆ Commercial buildings
- ◆ Replace conventional boilers, chillers, etc.
- ◆ Hybrid systems (peak demand)
- ◆ Groundwater treatment systems??

1 = Highest/Best
Comparative Rating

Good Things to Know

- ◆ 500 foot deep closed loop well ~ 2 ton cooling (24,000 Btu/hr)
- ◆ 1,500 foot deep standing column well ~ 20 tons cooling (240,000 Btu/hr)
- ◆ It's about the rock column! Not groundwater
- ◆ Groundwater quality is important
- ◆ Aquifer Thermal Conductivity (Btu/hr-ft-°F) is important

Questions?

